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## TO THE ASSISTANT COMMISSIONER FOR PATENTS

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Transmitted herewith for filing under 35 U.S.C. 111 and 37 C.F.R. 1.53 is the patent application of:

## OPTICAL PROBE WITH SAMPLING WINDOW CLEANING CONFIGURATION

For: Joseph B. Slater

Enclosed are:

Certificate of Mailing with Express Mail Mailing Label No. EK262388254US

Three (3) informal sheets of drawings.

A certified copy of a application.

Declaration  Signed.  Unsigned.

Power of Attorney

Information Disclosure Statement

Preliminary Amendment

Other:

## CLAIMS AS FILED

For	#Filed	#Allowed	#Extra	Rate	Fee
Total Claims	7	- 20 =	0	x \$18.00	\$0.00
Indep. Claims	1	- 3 =	0	x \$78.00	\$0.00
Multiple Dependent Claims (check if applicable)	<input type="checkbox"/>				\$0.00
				BASIC FEE	\$760.00
				TOTAL FILING FEE	\$760.00

A check in the amount of \$760.00 to cover the filing fee is enclosed.

The Commissioner is hereby authorized to charge and credit Deposit Account No. 07-1180 as described below. A duplicate copy of this sheet is enclosed.

- Charge the amount of as filing fee.
- Credit any overpayment.
- Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
- Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).

Dated: Nov. 16, 1999

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## **OPTICAL PROBE WITH SAMPLING WINDOW CLEANING CONFIGURATION**

### Reference to Related Application

This application claims priority from U.S. provisional application Serial No. 60/108,720, filed November 17, 1998, the entire contents of which are incorporated herein by reference.

5

### Field of the Invention

This invention relates generally to optical probes and, in particular, to a probe having a self-cleaning capability for use in on-line process control and other applications.

### Background of the Invention

Optical probes such as those used for Raman detection are increasingly being 10 employed in on-line process-control applications. In a typical configuration, this requires that at least the sampling optic be immersed directly into a process stream. In many cases, the process stream contains materials which tend to coat the optic, thereby reducing or completely eliminating the ability to collect data.

Many solutions have been tried to compensate for, or to remove, such coatings, 15 including ultrasonic cleaners, spray jets, mechanical "windshield" wipers, and even arrangements which automatically retract, clean and reinsert the probe. Each of these approaches has distinct disadvantages. Ultrasonic cleaners have difficulty maintaining sufficient energy density at the optic, and do not operate well in viscous fluids. Spray jets

are affected by process flows, and require large volumes of solvent. Mechanical approaches introduce unwanted sealing requirements into the process, and may pose safety and/or reliability problems.

Summary of the Invention

5        This invention resides in an optical probe with a self-cleaning sampling window, a feature which is particularly useful in on-line process-control environments. The concepts are ideally suited to Raman and fluorescence detection, through the apparatus and methods are not limited in this regard.

10      In terms of hardware, the apparatus includes a probe body having a window with a surface oriented toward a sample under investigation. A sampling beam carrying wavelengths representative of the sample passes into the probe body through the window for analysis. A conduit, preferably forming part of the probe body, is used to carry a fluid to the surface of the window oriented toward the sample, and a partition proximate to the window is used to direct the fluid across the window as a laminar or turbulent flow.

15      In a preferred configuration, the partition further includes an aperture through which the sampling wavelengths pass. This partition also permits a portion of the fluid to pass though the aperture to ensure that the sample under investigation does not reach the window. The fluid may be a liquid or gas, depending upon the nature of the sample, and is preferably a solvent to maximize window cleaning. Although the fluid may be 20 discharged without entering into the environment being sampled, the fluid may also be

discharged into the sample, depending upon the application, volume of the respective fluid/sample flows, and other such factors.

Brief Description of the Drawing

FIGURE 1 is a drawing in cross-section illustrating a preferred embodiment of the  
5 invention.

Detailed Description of the Invention

Broadly, and in general terms, this invention utilizes a flowing solvent as opposed to a jet-spray to keep clean a window used in conjunction with a sampling beam of a spectroscopic system. The approach is applicable to any form of optical sampling,  
10 including Raman detection, fluorescence, and so forth. In the preferred embodiment, the solvent used for cleaning is supplied as a laminar sheet over and past the surface of the window exposed to the process flow. Alternatively, other “fluids” may be used in lieu of solvents, including gases, particularly if applied in sheet form, depending upon the type of process flow involved.

15 The invention will be better understood with reference to Figure 1, which illustrates a preferred embodiment in cross-section generally at 100. Within a probe body 102, there is housed an optical channel 104 containing a sampling beam 106. A sampling lens 106 is used to focus the beam to a localized sampling zone 114 through a sampling port 116. In this example, it is assumed that the beam 106 includes both excitation (i.e.,  
10 laser) and collected wavelengths in a counter-propagating beam, though the invention is

applicable to a collection-only path, assuming no requirement for excitation, or excitation originating from a different direction.

Also contained within the probe body 102 are one or more delivery tubes 120, delivering the cleaning fluid into a gap 122 on the process side of window 112. A 5 partition 113 or other structure is provided to flood a small portion of the window actually used by the sampling beam, as shown, thereby protecting the window from contamination. It is also assumed that the solvent is substantially transparent to the wavelengths being collected through the window, such that the solvent itself will not contaminate or appreciably modify the sample spectra.

10 The solvent flow may be laminar or turbulent, and may be aspirated through the sample port and entrained through an output port 124 into the solvent flow. This ensures that a representative sample is always available to the sampling zone. Since there is a danger that materials within the process flow may clog the sample port, a second sample delivery tube 121 is positioned "downstream" of the window. Solvent introduced into the 15 tube 121 would serve to increase the back pressure and drive the solvent forceably out the sample port, thereby cleaning the entire sampling area.

It will appreciated to those of skill that the system just described may be operated continuously during data collection, or only on occasion to clean the window in between data collection events.

20 I claim:

1. An optical probe with a self-cleaning sampling window, comprising:
  - 2 a probe body having a window with a surface oriented toward a sample under investigation;
  - 4 a sampling beam carrying wavelengths representative of the sample into the probe body through the window for analysis;
  - 6 a conduit carrying a fluid to the surface oriented toward the sample; and a structure operative to flood the window with the fluid.
2. The optical probe of claim 1, wherein the wavelengths are representative of Raman spectra.
3. The optical probe of claim 1, wherein:
  - 2 the structure further includes an aperture through which the sampling wavelengths pass; and
  - 4 at least a portion of the fluid passes through the aperture to ensure that the sample under investigation does not reach the window.
4. The optical probe of claim 1, wherein the fluid is a solvent.

5. The optical probe of claim 1, wherein the fluid is a liquid.

6. The optical probe of claim 1, wherein the fluid is a gas.
7. The optical probe of claim 1, wherein the fluid enters into the sample under investigation after flooding the window.

Abstract of the Disclosure

A self-cleaning optical probe includes a probe body having a window with a surface oriented toward a sample under investigation. A sampling beam carrying wavelengths representative of the sample passes into the probe body through the window for analysis. A conduit, preferably forming part of the probe body, is used to carry a fluid to the surface of the window oriented toward the sample, and a partition proximate to the window is used to direct the fluid across the window as a laminar flow. The partition further includes an aperture through which the sampling wavelengths pass. This partition also permits a portion of the fluid to pass though the aperture to ensure that the sample under investigation does not reach the window. The fluid may be a liquid or gas, and is preferably a solvent to maximize window cleaning. Although the fluid may be discharged without entering into the environment being sampled, the fluid may also be discharged into the sample, depending upon the application, volume of the respective fluid/sample flows, and other such factors.

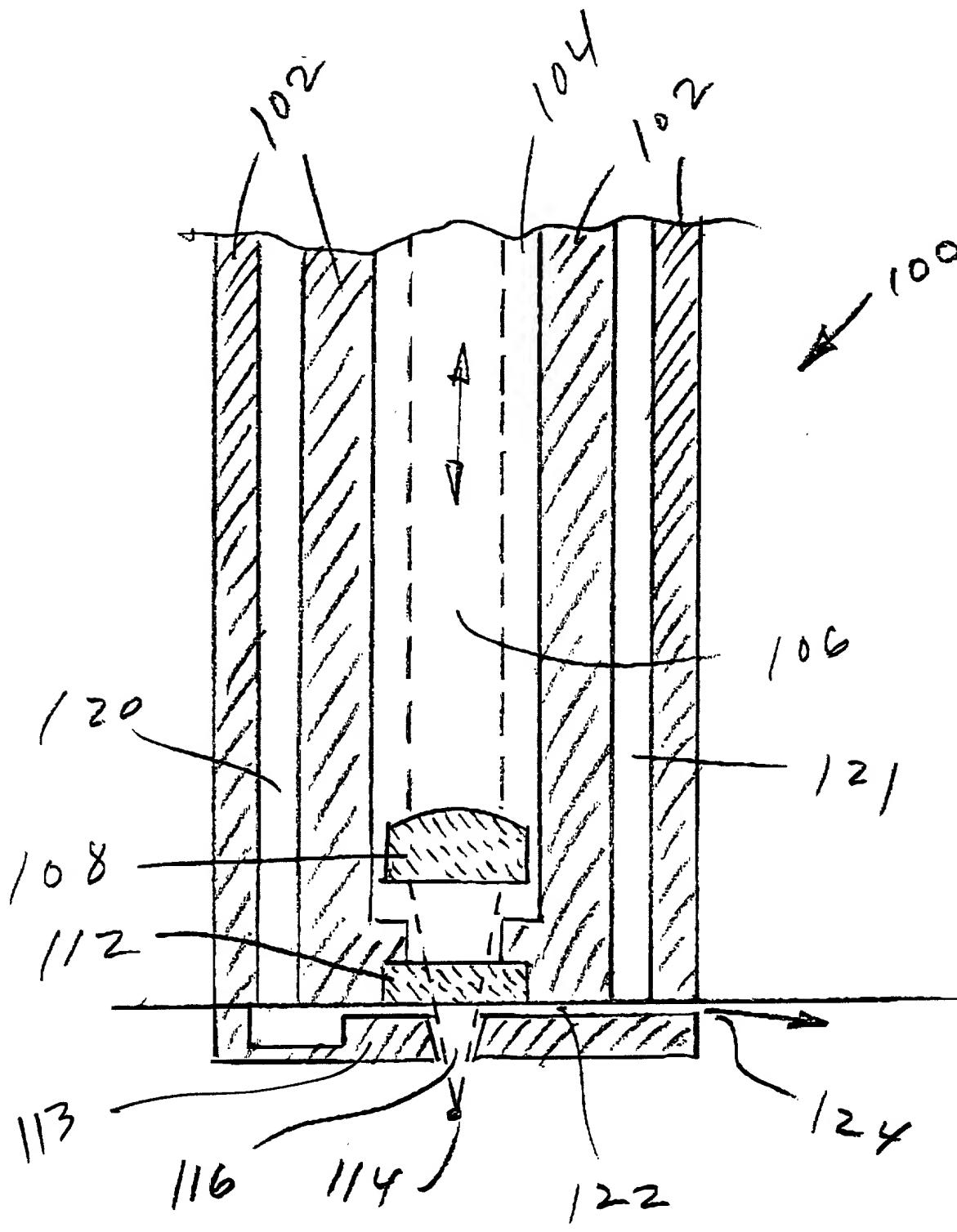


Fig - 1

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## COMBINED DECLARATION AND POWER OF ATTORNEY

*(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL,  
CONTINUATION OR CIP)*

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As the below named inventor, I hereby declare that:

### TYPE OF DECLARATION

This declaration is the following type:

- original
- design
- supplemental

*NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part do not check next item; check appropriate one of last three items.*

- national stage of PCT

*NOTE: If one of the following 3 items apply then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR CIP.*

- divisional
- continuation
- continuation-in-part (CIP)

### INVENTORSHIP IDENTIFICATION

*WARNING: If the inventors are each not the inventors of all the claims an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.*

My resident, post office address and citizenship are as stated below next to my name. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

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### OPTICAL PROBE WITH SAMPLING WINDOW CLEANING CONFIGURATION

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### SPECIFICATION IDENTIFICATION

the specification of which: *(complete (a), (b) or (c))*

(a)  is attached hereto.

(b)  was filed on \_\_\_\_\_ as  Serial No. 0 / \_\_\_\_\_ or  Express Mail No., as Serial No. not yet known \_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable).

*NOTE: Amendments filed after the original papers are deposited with the PTO which contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.*

(c)  was described and claimed in PCT International Application No. \_\_\_\_\_ filed on \_\_\_\_\_ and as amended under PCT Article 19 on \_\_\_\_\_ (if any).

#### **ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR**

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge to the duty to disclose information

■ which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56

*(also check the following items, if desired)*

and which is material to the patentability of this application, namely, information where there is a substantial likelihood that a reasonable examiner would consider it important in deciding whether to allow the application to issue as a patent, and

In compliance with this duty there is attached an information disclosure statement in accordance with 37 CFR 1.98.

#### **PRIORITY CLAIM (35 U.S.C. § 119)**

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

*(complete (d) or (e))*

(d) ■ no such applications have been filed.  
(e)  such applications have been filed as follows.

*NOTE: Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check Item (e), enter the details below and make the priority claim.*

#### **A. PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119**

Country (or indicate if PCT)	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 37 USC 119
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No

ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS  
(6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

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**NOTE.** *If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CIP APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120*

**CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S)**

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER	FILING DATE
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60/108,720	November 17, 1998
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**POWER OF ATTORNEY**

I hereby appoint the following attorneys and/or agents to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Ernest I. Gifford (Reg. No. 20,644)	Thomas E. Anderson (Reg. No. 31,318)
Allen M. Krass (Reg. No. 18,277)	Ronald W. Citkowski (Reg. No. 34,732)
Irvin L. Groh (Reg. No. 17,505)	Judith M. Riley (Reg. No. 30,311)
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John G. Posa (Reg. No. 37,424)	Avery N. Goldstein (Reg. No. 39,204)
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SEND CORRESPONDENCE TO:	DIRECT TELEPHONE CALLS TO:
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**DECLARATION**

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

## SIGNATURE(S)

Full name of sole inventor JOSEPH B. SLATER

Inventor's signature 

Date 11-11-99

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**CHECK PROPER BOX(ES) FOR ANY OF THE FOLLOWING ADDED PAGE(S)  
WHICH FORM A PART OF THIS DECLARATION** Signature for third and subsequent joint inventors. *Number of pages added* \_\_\_\_\_

\* \* \*

 Signature by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. *Number of pages added* \_\_\_\_\_

\* \* \*

 Signature for inventor who refuses to sign or cannot be reached by person authorized under 37 CFR 1.47. *Number of pages added* \_\_\_\_\_

\* \* \*

 Added pages to combined declaration and power of attorney for divisional, continuation, or continuation-in-part (CIP) application. *Number of pages added* \_\_\_\_\_

\* \* \*

 Authorization of attorney(s) to accept and follow instructions from representative.

\* \* \*

*If no further pages form a part of this Declaration then end this Declaration with this page and check the following item* This declaration ends with this page.